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NOTES ON THE PHILIPPINE FRIGATE MACKERELS FAMILY THUNNIDAE, GENUS *AUXIS*

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an expanded program of studying the composition of catches in local markets would reveal their presence throughout most of the Philippines.

Locality records for *Auxis thazard* other than the Philippines include the Hawaiian Islands, Sea of Japan, west coast of North America, the Mediterranean Sea, and the Atlantic Ocean. The second species under consideration, *Auxis tapeinosoma*, has been recorded from Japan and the Dutch East Indies.

Key to the Genus *Auxis* [3]

1a. First dorsal continuous or almost continuous with second dorsal; axillary scales between ventral fins small, about one-half length of fins----------(Thunnidae except *Auxis*)

1b. First dorsal not continuous or almost continuous with second dorsal.

Interspace between fins almost equal to length of head. Axillary scales between ventral fins equal in length to fins Genus *Auxis*

2a. Corselet scales along lateral line 2 to 4 irregular scale rows wide under origin of second dorsal. Corselet abruptly tapering to narrow band of 3 to 4 scales along lateral line at about midway between first and second dorsals. Total gill-raker count of first gill arch 37 to 43----------*Auxis thazard* (Lacépède)

2b. Corselet scales along lateral line in a wide band 7 to 12 irregular scale rows wide under origin of second dorsal. Corselet tapers gradually and evenly throughout length, ends under about second dorsal finlet. Total gill-raker count of first gill arch 44 to 48----------*Auxis tapeinosoma* Bleeker

There is considerable disagreement among taxonomists as to the number of valid species in this genus. Some believe there is a single world-wide species (*Auxis thazard*), while others are of the opinion that one or more additional species are to be found. It is quite evident, however, from the data at hand that two species occur in the Philipp A survey of the available literature shows possibly two seemingly similar species occur i eastern Pacific area. Comparison of two des tions of specimens of this genus (Meek and H brand 1923; and Fowler 1938) reveals that authors were describing two entirely different sp Fowler's description based on two specimens the Galapagos Islands off the west coast of S America agrees with *Auxis tapeinosoma* as de here, having the elongate posterior prolongati the corselet along the lateral line and the incr gill-raker count. The description by Meek Hildebrand based upon a composite collection specimens from Woods Hole, Mass., Hawaii, Java agrees in gill-raker count of the lower gill with *Auxis thazard* as named here. The spec used by Walford (1937) to illustrate *Auxis thaz* clearly identifiable as *A. tapeinosoma* with its posterior extension of the corselet along the la line. It is not known whether the eastern P forms are identical with the species occurri Philippine waters, and a careful study of a cons able number of collections will be necessary b this can be ascertained.

Two additional species of frigate mackerel, *A hira* and *A. maru*, were described from Japa waters by Kishinouye (1915). The descriptio the larger of the two Japanese species (*Auxis* agrees very well with specimens of Philippine *A thazard* as determined by Drs. Herre and He Until specimens from Japan are available for parison *hira* is provisionally placed in synon with *thazard*. The second, smaller species Japan, *Auxis maru*, seems identical with that w Dr. Herre provisionally names *A. tapeinosoma* a tentatively placed in synonomy with it.

[3] This key adapted from a memorandum to field biologists, Philippine Fishery Program, prepared by Dr. Earl S. Herald.

[4] Fork length is defined as the length from the tip of the snout to the end of the median caudal rays.

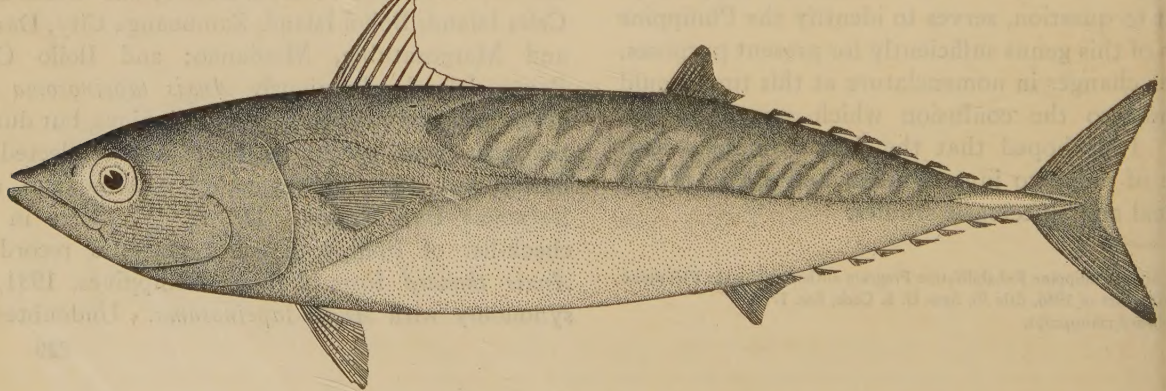

FIGURE 1.—Adult *Auxis thazard* 212 mm. fork length.[4]

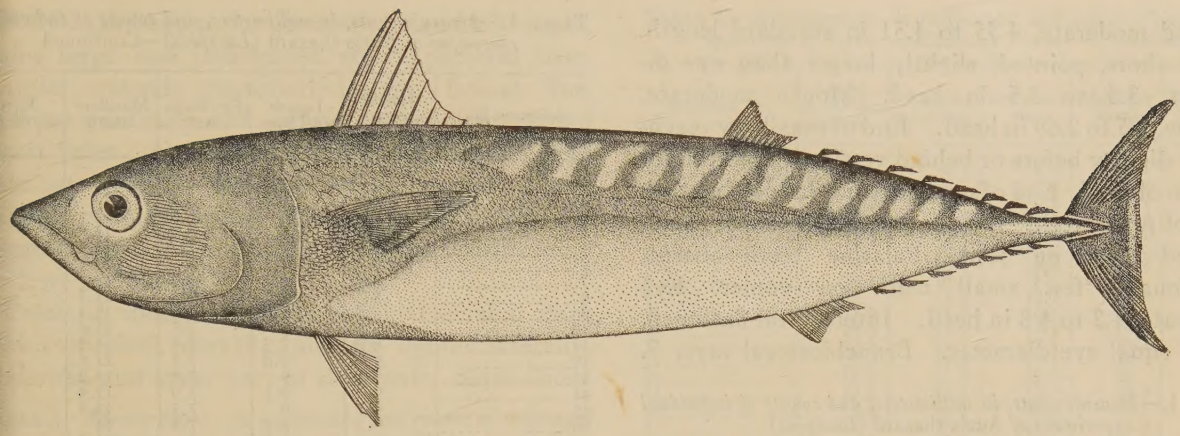

FIGURE 2.—Adult *Auxis tapeinosoma*, 228 mm. fork length.

Auxis thazard (Lacépède)

ıber thazard Lacépède, 1802, vol. 3, p. 9 (type locality between 6° and 7° S. latitude, off coast of New Guinea).
xis hira Kishinouye, 1915, Susan Gakkai Ho. I, p. 23, plate 1, fig. 16 (Japan).

Body robust, sides flattened, slightly compressed. rsal outline broadly and evenly curved, ventral line flattened abdominally. Depth 3.89 to 5.75 standard length; [5] depth increases gradually as becomes larger.

Head large, 3.95 to 4.35 in standard length. Snout rt, pointed, longer than eye diameter, 3.3 to 3.6 ıead. Mouth moderate, oblique, end of maxillary ches to or slightly past vertical from anterior edge ɔupil. End of maxillary not hidden beneath edge ɔreorbital. Jaws equal or lower jaw slightly pro- ting in larger specimens. Single row of small, nted teeth on both jaws. Palatine teeth absent, asionally a few small, scattered teeth on vomer. es moderate, placed high on sides of head, 4 to 4 in head. Interorbital wider than eye, some- at flatly rounded. Branchiostegal rays, 7. Gill mbranes not united, free from isthmus. Gill ers, long and slender, 9–10+1+27–32 on first arch.

Dorsal fins two, separated by interspace slightly rter than head length. First dorsal roughly tri- ɡular, X to XII (mostly XI to XII). Anterior ıe longest, equal to fin base. Second dorsal all, 10 to 12 (mostly 11 to 12) rays. Dorsal fin- , 8. Anal fin small, II, 8 to 11, origin under last of second dorsal. Anal finlets, 7 (8 in one speci- n). Pectoral fin short, roughly triangular, tip of reaches almost to end of first dorsal base. Ventral fins thoracic. Axillary scales equal ventrals in length.

Body naked except for a corselet of scales anteriorly. Corselet scales large and imbricated above pectoral base. Corselet extends posteriorly along lateral line, tapering abruptly to a narrow band about halfway between end of first dorsal and origin of second. Only 2 to 4 irregular scale-rows wide at second dorsal origin. Caudal peduncle small, lateral keels poorly developed. Lateral line without a distinct arch and more or less undulating.

Color of formalin-preserved specimens: dorsally deep brown or blackish becoming slightly paler laterally. Abdomen and lower portion of sides pale, sometimes light brown or gray. Sides above and behind corselet with elongate irregular, oblique black bars. First dorsal light brown along anterior spines. Other fins almost colorless.

The following material was examined: 24 specimens, 103.7 to 367 mm. standard length, Batangas Public Market, Batangas, Luzon, July 1, 1948; 4 specimens, 170 to 204.6 mm. standard length, Zamboanga City Market, Zamboanga, Mindanao, February 28, 1948. A series of measurements adapted from Godsil and Byers (1944) was made on these specimens. A summary of these measurements is given in table 1.

Auxis tapeinosoma Bleeker

Auxis tapeinosoma Bleeker, 1854, p. 408 (Nagasaki, Japan).
? *Auxis maru* Kishinouye, 1915, p. 24, plate 1, fig. 19 (Japan).

Body robust, rounded, almost cylindrical in cross section. Dorsal outline moderately and evenly curved. Ventral outline similar, but slightly flattened in abdominal region. Depth 5.3 to 6.1 in standard length.

[5] tandard length is defined as the length from the tip of the snout to the end e hypural plate.

Head moderate, 4.35 to 4.51 in standard length. Snout short, pointed, slightly longer than eye diameter, 3.3 to 3.5 in head. Mouth moderate, oblique, 2.5 to 2.69 in head. End of maxillary reaching to slightly before or behind vertical from anterior margin of eye. End of maxillary not hidden beneath edge of preorbital. Jaws equal, single row of small, pointed teeth on jaws. Palatine teeth absent, occasionally few small teeth on vomer. Eye moderate, 4.2 to 4.8 in head. Interorbital flattened, width equal eye diameter. Branchiostegal rays, 7.

TABLE 1.—*Measurements, in millimeters, and counts of individual specimens of* Auxis thazard (*Lacépède*)

Specimen No.	Standard length	Fork length	Head length	Snout to first dorsal insertion	Snout to second dorsal insertion	Snout to anal insertion
1	103.7	109	24	32	65	69
2	110.5	116.2	28	37	69.5	76
3	115.5	122	28.5	37	73	79
4	118	124	28.5	37.5	74	78
5	121.5	127.5	29.2	37.6	75	80.8
6	123	128.5	29.5	38.6	78	83.2
7	135.4	140.2	32.5	42.1	82.9	91
8	135.5	140.6	33	43	83	90.5
9	137.4	144	33	43.2	84	92
10	139	145	33.5	44.1	85	94
11	142	147.9	33.5	44.5	88	95.2
12	142	147	35	43.8	88	96
13	142.5	148.5	34.7	45.6	89	93.3
14	143.2	149.4	33.5	45.1	88	95.5
15	144.5	150	34	46.2	90.1	95.6
16	144.5	150	33.1	45.2	89	96
17	151	156	35.1	46.8	93.5	101
18	154	159	35.6	49	100.4	100
19	156.7	162	37.5	49	95.2	104
20	170	176.9	40.4	53.1	104	111.9
21	182.8	188.7	43.9	56.8	113	124.1
22	186.4	193	43	58.2	115.1	126.1
23	196	204.6	46.7	62.3	122.7	134.5
24	301.5	315	75.2	109.8	196.5	213.6
25	326.9	337	80.5	106.7	216	240.9
26	334.6	346	80.6	108	213	238.9
27	338	350	83.4	110	231.1	245.5
28	367	377	89.4	119	234.5	264.8

Specimen No.	Depth	Pectoral base to first dorsal insertion	Length first to second dorsal insertion	Pectoral length	Length first dorsal base
1	18	9	33.5	10	16
2	21	11.5	35.2	10.8	18.5
3	23	13	35	12	18
4	23	12.5	37.7	11	17
5	24.9	12.5	38.2	12.8	20.5
6	24	13	39.5	12.5	20.5
7	25.7	14.1	43	14.1	18.2
8	26	14.2	42.6	14.5	19.2
9	28	14	43.5	14	20
10	25.8	15	43.2	14	20.2
11	28.5	15.2	46	14.8	24.5
12	29	16	45	14.8	23
13	27.8	15	46.2	14.2	21.6
14	28.1	15.9	45.9	14.9	21
15	29.1	15.1	45.2	15	20
16	28.2	15	45	14.7	20.5
17	29.2	17	48.2	14.6	22
18	31.1	17.4	48	16.5	22.5
19	32	18.2	49	16.9	26.1
20	31	18	56.4	18.1	23.2
21	34.3	17.8	56.1	20.2	28.7
22	34.2	19.7	58.8	21.6	27.5
23	43.1	21	62.1	21.9	27.9
24	74.2	38	98.2	40.5	39.9
25	84.2	40.1	109.8	47	42.4
26	84.1	42.4	105.5	45.4	44
27	85	42.8	112	51.6	46.9
28	88	47.8	116.2	54.9	48.9

TABLE 1.—*Measurements, in millimeters, and counts of individual specimens of* Auxis thazard (*Lacépède*)—Continued

Specimen No.	Length second dorsal base	Length anal base	Eye diameter	Maxillary length	First dorsal
1	5	5.2	6	10	
2	6	6.2	6.5	12	
3	6	6	6.5	12	
4	6.2	6	6.5	12	
5	7.7	7.2	7	12.1	
6	7	7.2	7	12	
7	8.3	8.1	7.2	13	
8	8	8.2	7.7	13.3	
9	8.5	8.8	7.5	13.1	
10	8.8	9	7.5	13.6	
11	8.6	8.5	7.4	14.2	
12	9	8.6	7.5	13.8	
13	9.1	9	7.2	13.2	
14	9	9.1	7.9	13.4	
15	9.1	9	7.3	13.8	
16	9.2	8.5	7.5	14	
17	9	9.5	8	14.7	
18	10.5	9.5	8	14.5	
19	9.5	10.5	7.9	14.7	
20	11.1	10	8.2	15.7	
21	11	10.9	9.4	17	
22	12.5	10.6	9.8	17.1	
23	10.8	11.2	9.9	18.4	
24	19.3	16	15	28.8	
25	18.8	20.3	16.1	30.9	
26	20	18.1	16.2	30.9	
27	19.9	20.2	17.4	31	
28	21	20.4	17.2	33.6	

Specimen No.	Second dorsal rays	Dorsal finlets	Anal finrays	Anal finlets	Gill rakers
1	11	8	11	7	9+1
2	10	8	13	7	10+1
3	11	8	10	7	8+1
4	11	8	10	7	9+1
5	11	8	12	7	10+1
6	10	8	13	7	10+1
7	11	8	12	7	10+1
8	12	8	13	7	10+1
9	11	8	13	7	9+1
10	12	8	12	7	9+1
11	12	8	12	7	10+1
12	12	8	12	7	10+1
13	11	8	12	7	10+1
14	12	8	13	7	10+1
15	11	8	14	7	10+1
16	12	8	13	7	10+1
17	12	8	13	7	10+1
18	12	8	13	7	10+1
19	10	8	14	7	10+1
20	11	8	13	7	9+1
21	11	8	14	7	9+1
22	11	8	13	7	10+1
23	11	8	14	7	8+1
24	12	8	13	7	9+1
25	11	8	14	7	10+1
26	11	8	12	8	9+1
27	11	8	13	7	11+1
28	11	8	13	7	10+1

Gill membranes not united, free from isthm
Gill rakers long and slender, 10–12+1+31–35.

Dorsal fins two, first dorsal X to XI, roug
triangular, anterior spine longest, almost equal
base of fin. Second dorsal small, 10 to 12 (mostly
rays. Dorsal finlets, 7 (8 in one specimen). A
fin small, II, 10 to 12, origin at vertical through
ray of second dorsal. Anal finlets, 7. Pectoral
roughly triangular, tip of fin more or less reac
end of first dorsal base, 8.95 to 9.91 in stand
length. Ventral fins thoracic, axillary scales l
equal to ventral fin.

Body naked except for corselet of scales anteriorly. ales large and imbricated above pectoral base. rselet extends posteriorly along lateral line, pering gradually and ending under about second rsal finlet. Corselet, 7 to 12 irregular scale rows de at vertical through second dorsal origin. udal peduncle small, lateral keels poorly deloped. Lateral line without distinct arch, more less undulating.

Color of specimens preserved in formalin: dark own or black dorsally, slightly lighter laterally. odomen and lower part of sides pale. Sides above

BLE 2.—*Measurements, in millimeters, and counts of individual specimens of* Auxis tapeinosoma *Bleeker*

ecimen No.	Standard length	Body length	Head length	Snout to first dorsal insertion	Snout to second dorsal insertion	Snout to anal insertion
	122	126.7	27.7	36.5	76.1	83.4
	129	134.1	29.6	39.7	82.5	89
	161.9	167.5	38.5	47.3	102.5	112.2
	186.9	193	41.6	57	118.8	129.4
	190	196.7	43.1	56.2	122	132
	191.9	186.1	41.2	54.9	118.1	128.8
	192	199.5	43.6	57.9	124.2	133
	192.5	200.8	44.2	59.1	124	135
	196.2	205	44	58.8	126.4	136.6
	199.1	207.5	44.1	60.1	125.6	138.1
	215	221.8	51.9	69.7	137.3	150
	215	224	52	68.8	140.4	154
	215.9	222.5	51.4	69	144.2	147.5
	217	224	52.7	69.2	140.5	150.1
	217.4	223.5	51.1	67.9	139	152.5
	218	224.1	52.9	69.2	139.9	153
	219.8	228	52.8	70.1	145	155.5
	220.2	227.1	51.8	69.9	142.1	149.1
	221	228.7	52.2	70.1	144	154
	221.1	225.8	54	70.4	141	153.2
	222	229	54.6	73.1	147.5	152.1
	222.2	230.3	54.4	71.4	145	154.5
	222.4	230.1	54.9	70	147.8	159.9
	222.8	231	52.4	67.5	144.9	156.8
	222.9	228.1	52.1	68	142.2	154
	225	233	53.9	70.9	145.3	157.9
	228	235.2	52.9	70	148	161.2
	231	237	54.2	73.1	152.2	160.2

Specimen No.	Depth	Pectoral base to first dorsal insertion	Length first to second dorsal origin	Pectoral length	Length first dorsal base
	20.2	11.2	41	12.3	15.2
	21.1	12.5	45.1	13	19.1
	30.8	17.2	57	17	19.9
	35	19.9	64.9	20	23
	35.8	20.7	67	21.2	22.9
	35.1	19.5	66.5	20.3	21.8
	35.9	21	68	21.5	22.4
	36.6	20	67.1	21.2	25.3
	38.1	21.6	68.5	22.2	24.3
	37.6	21.2	68.1	21.9	24.7
	44.1	25.9	72.2	27.9	26
	45	25.2	74.4	28.1	27.5
	43.6	24.1	80.4	27.2	27
	46.1	25.8	77	28	27.2
	44	25.2	73.2	26	25.8
	44.4	25.2	72.6	28	26.1
	46.4	25.1	78	28.1	25.2
	47.7	25.9	77	27.8	28.6
	43.1	24.2	77.5	29	26.8
	44.3	25	75.2	28.8	29.3
	48.2	26.8	78.9	28.9	29.2
	48.9	26	77.1	30	23.1
	45	25.1	80.4	29.9	29.2
	47.2	24.6	78.7	29.2	29.5
	46.7	24.9	77.3	28.5	27.1
		25.9	79.9	28.3	28.8
	49	26.1	80.9	28.9	26.8
	47.1	26.9	83.6	29	27.8

TABLE 2.—*Measurements, in millimeters, and counts of individual specimens of* Auxis tapeinosoma *Bleeker*—Continued

Specimen No.	Length second dorsal base	Length anal base	Eye diameter	Maxillary length	First dorsal rays
1	7	6.1	6.6	11	10
2	8	8.7	7.5	11.8	10
3	9.1	10	9.1	14.1	10
4	10.4	10.3	10.5	16.4	11
5	10.5	10.4	10.2	16.2	10
6	11.7	10.4	11	16.1	10
7	9.5	10.1	10.8	16.3	10
8	10.7	10.6	10	16	10
9	12	11.2	10.1	16.3	10
10	11.9	11.7	10.1	16.5	10
11	15.1	13.2	12.4	19.2	10
12	12.2	11.7	12.1	19.1	10
13	11.1	11.9	12.1	19	10
14	11.1	11.8	12.7	20	10
15	12.5	11.1	12.7	19.2	10
16	13.3	11.3	12.6	19.7	10
17	12	12.5	12.8	19.9	10
18	13.1	12.2	12.6	19.2	10
19	11	11.2	12.4	19	10
20	13.9	13.8	12.1	20.4	10
21	12.7	11.2	12.4	20	10
22	10.3	12.2	12.8	20	9
23	12.9	13.6	13	20.4	10
24	12.5	13.5	12.1	20	10
25	12	11	12.3	19.8	10
26	12.2	12.1	13	20.7	10
27	12.9	11.9	12.2	19.9	10
28	12.9	12.2	12.8	20.1	10

Specimen No.	Second dorsal rays	Dorsal finlets	Anal fin rays	Anal finlets	Gill rakers
1	11	8	12	7	11+1+35
2	11	8	12	7	11+1+33
3	11	8	14	7	11+1+34
4	11	8	13	7	10+1+34
5	11	8	13	7	11+1+32
6	11	8	14	7	[1]
7	11	8	13	7	11+1+33
8	11	8	14	7	11+1+33
9	11	8	12	7	10+1+34
10	11	8	13	7	[1]
11	12	8	13	7	11+1+31
12	11	8	14	7	11+1+35
13	10	8	13	7	11+1+35
14	11	8	13	7	10+1+33
15	11	8	14	7	11+1+35
16	11	8	14	7	11+1+34
17	11	8	13	7	10+1+33
18	11	8	13	7	11+1+34
19	11	8	13	7	11+1+34
20	12	8	14	7	11+1+33
21	11	8	12	7	10+1+35
22	11	8	13	6	10+1+33
23	12	8	14	7	11+1+34
24	11	8	13	14	10+1+34
25	11	8	14	7	11+1+35
26	11	8	14	7	11+1+34
27	11	8	12	7	11+1+33
28	11	7	14	7	10+1+34

[1] Specimen not deformed; no indication of injury to this part.

and behind corselet with elongate, black spots or more or less wavy bars. First dorsal with light brown along anterior spines, remainder of fins more or less colorless.

The following material was examined: 21 specimens, 122 to 231 mm. standard length, Batangas Public Market, Batangas, Luzon, July 2, 1948; 7 specimens, 186 to 199 mm. standard length, Zamboanga Public Market, Zamboanga City, Mindanao, February 28, 1949. A series of measurements similar to those made on *Auxis thazard* were made and are tabulated in table 2.

Several external characters and one easily accessible internal structure serve to distinguish the two Philippine species, the most obvious of which is the length of the posterior prolongation of the corselet along the lateral line. In *Auxis thazard* the corselet tapers abruptly toward the lateral line, narrowing rapidly to a few irregular scale rows above and below the lateral line about half way between the first and second dorsals. The corselet is 2 to 4 irregular scale rows wide at a vertical through second dorsal. In large specimens (350 to 400 mm. standard length) the corselet tapers less rapidly than in small specimens, but in no case does it extend to below the origin of the second dorsal. In the field it may be difficult to determine the end of the taper of the corselet, especially if the fish is moist or covered with slime. Turning the fish so that the light is reflected at the proper angle or drying the side of the fish will, however, aid in revealing it.

In contrast to the abrupt tapering of the corselet in *Auxis thazard*, the corselet of *A. tapeinosoma* decreases gradually almost the entire length of the body, and ends slightly before or behind the second dorsal finlet. At a vertical through the origin of the second dorsal the corselet is 7 to 12 irregular scale rows wide. The difference between the corselets of the two species is easily seen after a few specimens of each have been examined.

Another character that can be used in the field to separate the two species is the roundness of the body and the general appearance of the fish. The body is almost perfectly rounded, fusiform, cigar-shaped in *Auxis tapeinosoma*, but in *Auxis thazard* the body is definitely compressed, the sides are flattened, not rounded as in *tapeinosoma*. After a few specimens have been handled the feel and appearance of the fish are useful in a rough sorting of the two species.

The total gill-raker count is an excellent means of separating these two forms. Only a slight overlap in count occurs between the species, and the length of the posterior extension of the corselet easily distinguishes the two forms when this occurs. The gill rakers of 161 specimens of *A. thazard* and 55 specimens of *A. tapeinosoma* were counted and in one specimen only did the total count of *A. tapeinosoma* fall within the upper limit of that of *A. thazard*. The total gill-raker count on the first gill arch of *A. thazard* varies from 37 to 43, and with one exception, *A. tapeinosoma* has a count of 44 to 47 (43 in one specimen). Table 3 gives the total gill-raker count on the first gill arch of the two species and table the total count in its component parts.

The two species may be differentiated also b several minor taxonomic characters such as hea length, depth, tip of snout to anal origin, and leng of first to second dorsal origins. Table 5 is a sur mary of several proportional measurements betwe specimens of approximately the same length of t two species.

TABLE 3.—*Total gill-raker counts of* Auxis thazard *and* Au tapeinosoma

Total number of gill rakers	*Auxis thazard*	*Auxis tap inosoma*
37	2	---
38	14	---
39	39	---
40	48	---
41	30	---
42	23	---
43	5	---
44	---	
45	---	
46	---	
47	---	
Total number of specimens examined	161	

TABLE 4.—*Gill-raker counts of* Auxis thazard *and* Auxis tapeinosoma

Specimen	Upper arch				Center	Lower arch							
	8	9	10	11	1	27	28	29	30	31	32	33	34
A. thazard	2	70	88	1	161	3	26	53	46	26	5	---	---
A. tapeinosoma	---	2	24	29	55	---	---	---	---	---	2	15	26

	Upper arch and center gill raker	Lower arch							
		27	28	29	30	31	32	33	34
A. thazard	8+1	---	1	---	1	---	---	---	---
Do	9+1	1	15	27	22	5	2	---	---
Do	10+1	2	10	26	23	21	3	---	---
A. tapeinosoma	9+1	---	---	---	---	---	---	2	4
Do	10+1	---	---	---	---	---	---	9	9
Do	11+1	---	---	---	---	---	1	5	14

Juvenile Stages of the Genus *Auxis*

Juvenile forms of the genus *Auxis* have previou been recorded from other parts of the world, b until now nothing has been known of the juven forms from the western Pacific. In the Medit ranean, De Buen (1932), Sparta (1933), Sella (192 and Ehrenbaum (1924) have reported the young this genus, and Schaefer and Marr (1948) discover and studied juvenile forms from the west coast central America. During the course of the first y of field work, the biological staff of the Philipp Fishery Program collected 19 specimens of you

E 5.—*Summary of counts and proportional measurements*[1] *of specimens of* Auxis thazard *and* Auxis tapeinosoma *of approximately equal length*

Item	*A. tapeinosoma* 186–190	*A. thazard* 182–186.4	*A. tapeinosoma* 192–199.1	*A. thazard* 196	*A. tapeinosoma* 122–129	*A. thazard* 118–123	*A. tapeinosoma* 161.9	*A. thazard* 154–156.7
to first dorsal	4.4–4.5	4.15–4.35	4.36–5.1	4.2	4.35–4.14	4.16–4.2	4.5	4.19–4.32
to second dorsal	3.28–3.4	3.2–3.21	3.28–3.33	3.15	3.25–3.34	3.15–3.23	3.42	3.14–3.21
to anal	1.56–1.57	1.61–1.66	1.54–1.58	1.6	1.56–1.76	1.57–1.74	1.57	1.48–1.62
	1.44	1.47–1.48	1.42–1.44	1.34	1.45–1.56	1.48–1.51	1.44	1.50–1.54
	5.3–5.31	5.26–5.45	5.14–5.35	4.55	6.05–6.1	4.9–5.3	5.24	4.9–4.95
al to first dorsal	9.2–9.95	9.5–10.1	9.08–9.42	9.3	10.3–11.5	9.45–10.1	9.38	8.6–8.85
first to second dorsal origin	2.8–2.88	3.2–3.24	2.83–2.93	3.15	2.86–2.98	3.12–3.18	2.83	3.2–3.25
al length	8.95–9.35	8.62–9	8.83–9.12	8.95	9.91–9.93	9.5–10.8	9.5	9.28–9.35
orsal base	6.68–8.54	6.15–6.8	7.60–8.6	7.02	6.75–8.1	4.92–7.15	8.1	6.0–6.85
dorsal base	15.9–18.1	14.9–16.6	16.3–20.2	19.2	16.2–17.6	15.6–19	17.2	14.6–18.4
ase	17.8–18.3	16.7–17.6	17–19	17.3	14.8–21.1	15.9–19.7	16.2	14.9–16.2
	3.71–4.22	4.4–4.66	4.04–4.42	3.71	8.94–4.2	4.17–4.3	3.98	4.45–4.78
ary	2.56–2.66	2.52–2.58	2.67–2.76	2	2.5–2.52	2.32–2.46	2.54	2.46–2.55
orsal	10–11	11–12	10	11	10	11	10	10–11
dorsal	11	11	11	11	11	10–11	11	10–11
finlets	8	8	8	8	8	8	8	8
	13–14	13–14	12–13–14	14	12	10–12–13	14	13–14
nlets	7	7	7	7	7	7	7	7
kers	10+1+34	10+1+31	11+1+33	9+1+29	11+1+33	9+1+29	11+1+34	10+1+31
o	11+1+32	8+1+30	11+1+33		11+1+35	10+1+31		10+1+30
o			10+1+34			10+1+27		

All proportional measurements are expressed in millimeters and are into standard length, except the maxillary which is into head length.

is. Four specimens were collected by night- operations from the research vessel *Spencer F. rd*, two by the experimental fishing vessel *ɔdore N. Gill*, and thirteen were found in the lic markets of Menado, Celebes, Dutch East es, and Batangas, Luzon, Republic of the ippines.

Twelve of the preceding juvenile specimens, identified as *Auxis thazard*, were collected from the following localities: 3 specimens, 21.8 to 26 mm. standard length, Minis Island, Pilas Island Group, Sulu Archipelago, lat. 6°36′ N., long. 121°34.5′ E., night light, May 7, 1948, *Spencer F. Baird;* 1 specimen 43.5 mm. standard length, Marigabato Point,

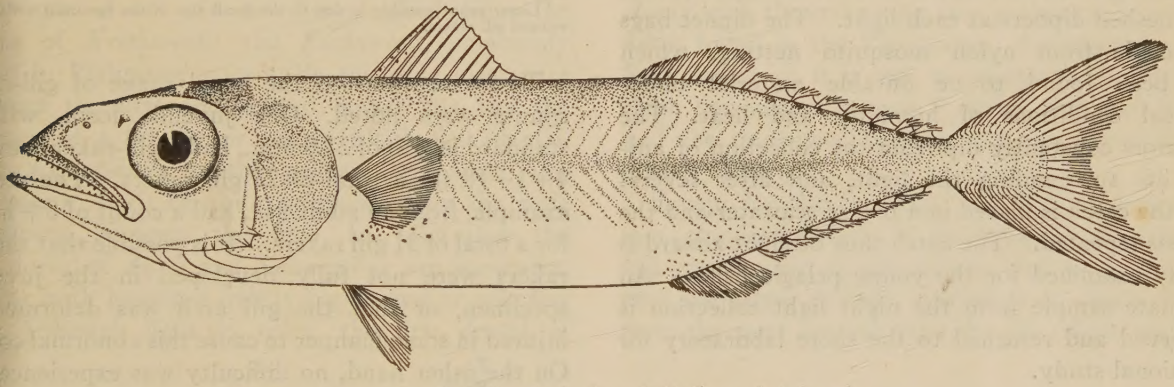

FIGURE 3.—Juvenile *Auxis thazard*, 23.1 mm. fork length.

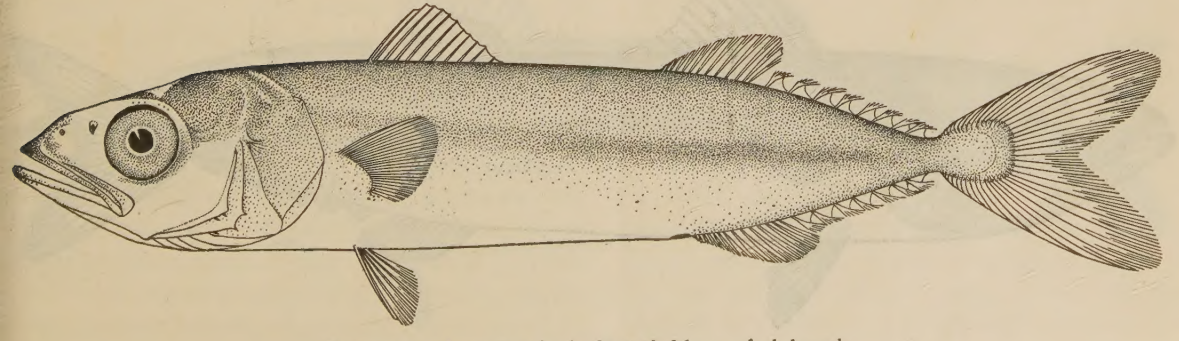

FIGURE 4.—Juvenile *Auxis thazard*, 26 mm. fork length.

southern Mindanao Island, lat. 7°21′ N., long. 124°12′ E., May 11, 1948, night light, *Spencer F. Baird;* 1 specimen 22.6 mm. standard length, Mouth of Sibuguey Bay, Mindanao Island, April 7, 1948, night light, *Theodore N. Gill;* and 7 specimens 45 to 55 mm. standard length, Batangas Public Market, Luzon, April 20 to 30, 1948.

Seven specimens of young *Auxis tapeinosoma* were captured at the following stations: 6 specimens 42 to 75.6 mm. standard length, Menado, Celebes, Dutch East Indies, March 6, 1948, night light, *Spencer F. Baird,* and market collections; 1 specimen 32 mm. standard length, Lamhil Island, near Basilan Island, Zamboanga, Mindanao, April 15, 1948, night light, *Theodore N. Gill.*

Extensive night-light operations carried out under a wide variety of conditions and localities have revealed but relatively few young tuna or tuna-like fishes. Those taken were collected during the first half of May 1948. Both over-water and submerged lights were tested, but for attracting the larger macroplankton and larval fishes it is believed that the under-water light is more satisfactory. A light suspended above the surface of the water seems to be more attractive to the larger fishes. Two lights are used at each station and one or two men operate fine-meshed dipnets at each light. The dipnet bags are made from nylon mosquito netting, which has been found to be durable material under tropical conditions of humidity and heat. The operators constantly dip from the collection of animal life surrounding the light, and after several dips the catch is placed in a pail of seawater and the process repeated. The catch thus brought aboard is closely examined for the young pelagic fishes. An adequate sample from the night light collection is preserved and returned to the shore laboratory for additional study.

Careful study of the juvenile *Auxis* in the co tion shows that, as in the case of the adults, can be separated into two species on the basis of raker counts. These counts are tabulated in t 6 and 7. The gill rakers correspond to the adul the two species found in these waters, *A. tha* and *A. tapeinosoma.* All gill-raker counts were m under 45 to 60 diameter magnification with a v field binocular microscope and every nodule cating the development of a gill raker was tabul No doubt some errors may have been made in gill-raker count of very small specimens, bu difficulty should be experienced in specimens 2 30 mm. standard length.

TABLE 6.—*Standard length and gill-raker count of juvenile* thazard

Standard length (millimeters)	Gill-raker c
21.8	[1] 4+1+
22.6	10+1+
26	7+1+
26	10+1+
43.5	10+1+
44	8+1+
46	8+1+
47	9+1+
47	9+1+
48	9+1+
49	8+1+
55	9+1+

[1] Lesser count possibly is due to the small size of the specimen with veloped gill rakers.

Two exceptions to the usual range of gill-r counts were noted. One juvenile form, wit standard length of 21.8 mm., had a gill-raker cou 4+1+18 for a total of 23 gill rakers. The se example, from an adult fish, had a count of 8+1 for a total of 31 gill rakers. It is possible that th rakers were not fully developed in the juv specimen, or that the gill arch was deforme injured in some manner to cause this abnormal co On the other hand, no difficulty was experience

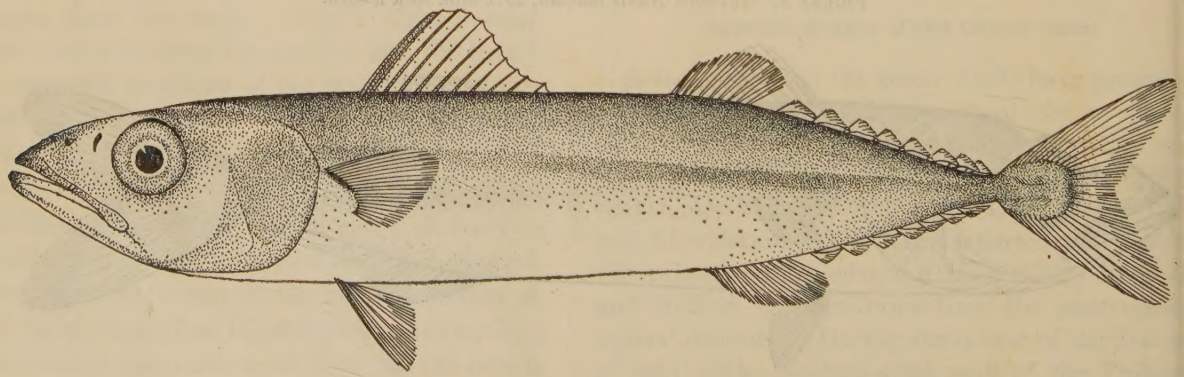

FIGURE 5.—Juvenile *Auxis thazard,* 46.5 mm. fork length.

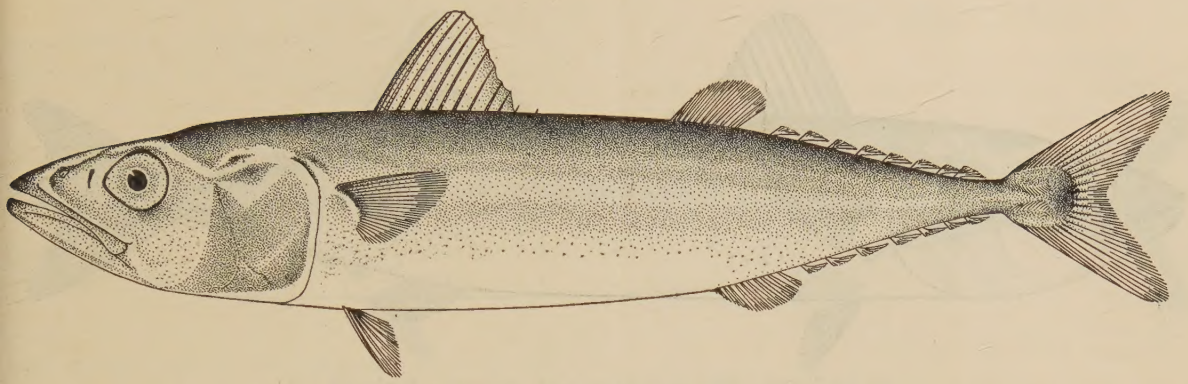

FIGURE 6.—Juvenile *Auxis thazard*, 57.2 mm. fork length.

ıting the gill rakers of specimens of similar size there was no indication of abnormality or injury ıe gill arch. The large gill arch from a mature imen was found in a collection of adult *Auxis* gill rs made at Batangas, Luzon. Examination of gill arch showed that it appeared normal in every . Unfortunately, the specimen was not preserved is unavailable for study. Since one of the two lamental differences between the two species of ippine *Auxis* is the difference in the gill-raker ıts, it is possible that a third species may be ent in the islands, although extremely rare.

ıvenile *Auxis* can be distinguished from the ıg of *Neothunnus* and *Euthynnus*, commonly d in Philippine waters, by the wide interspace veen the first and second dorsal fins and the nce of a wholly or partly black first dorsal. n *Katsuwonus*, another genus of the same fam- young *Auxis* can be distinguished by the wide rspace between the fins. In coloration the dorsal of *Auxis* and *Katsuwonus* are somewhat lar both having a lightly pigmented or colorless Although light in color, the first dorsal of *Katsuwonus* possesses more pigment than that of *Auxis*. Distally the first dorsal of *Katsuwonus* is more or less light brown or tan in color, while in *Auxis* the color is confined to a few scattered chromatophores along several of the anterior rays.

The young of two genera of the family Scombridae, possibly, can be also confused with young *Auxis*. These genera, *Rastrelliger* and *Pneumatophorus*, while possessing the wide interspace between the dorsal fins, have only 5 dorsal and anal finlets in contrast to 8 dorsal and 7 anal finlets of *Auxis*. Although there is little chance of confusing juvenile *Auxis* with the remaining two genera of Scombroid fishes found in the Philippines, *Acanthocybium* and *Scomberomorus*, it is well to point out that each of these two genera possess 9 dorsal and anal finlets, and the interspace between the two dorsal fins is greatly reduced.

Except for the fact that the small specimen (32 mm. standard length) of *Auxis tapeinosoma* has its full complement of gill rakers, one would suppose that the larger juvenile specimens of *Auxis thazard* were the same species with the gill rakers not fully

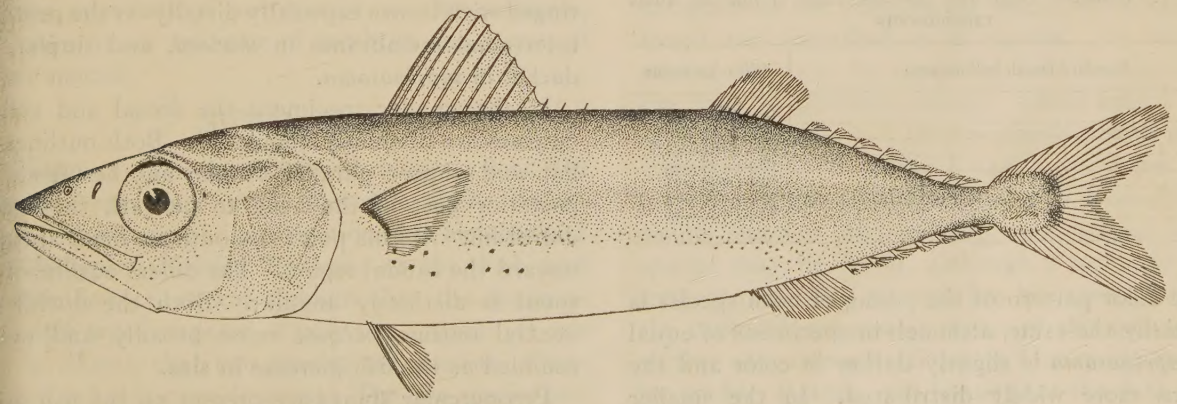

FIGURE 7.—Juvenile *Auxis tapeinosoma*, 33 mm. fork length.

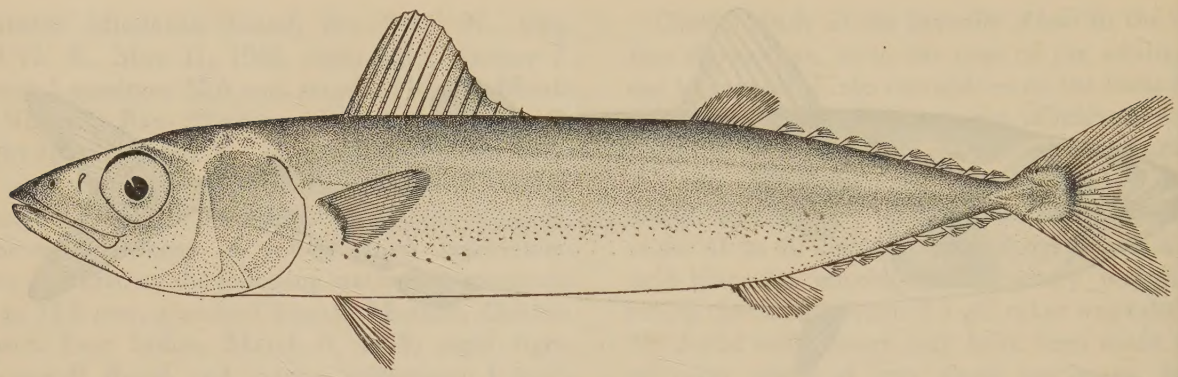

FIGURE 8.—Juvenile *Auxis tapeinosoma*, 44 mm. fork length.

developed. Counts made on both species (tables 6 and 7) show that this cannot be so, for the two counts widely overlap in the standard lengths of the two species. On the basis of present knowledge, it would seem that the supposition of Schafer and Marr (1948) is correct, that possibly they had the juvenile forms of two species. They list two specimens (52 and 54 mm. total length) with a total gill-raker count of 48 and 46, well within the limits of the total count for that of *tapeinosoma*. They also recorded total gill-raker counts of 39, 41, and 42 for specimens 42, 48, and 68 mm. in total lnegth, which fall within the limits of those for *Auxis thazard*, as here defined. Schaefer and Marr also refer to two adult specimens of *Auxis* from Culion, Republic of the Philippines, and from the gill-raker counts, it is possible that they also belong to two species. The specimen with the gill-raker count of 12+35=47 is most likely *A. tapeinosoma*, and the second specimen with a count of 11+32=43 gill rakers seems to be *A. thazard* as classified in this paper.

TABLE 7.—*Standard length and gill-raker count of juvenile* Auxis tapeinosoma

Standard length (millimeters)	Gill-raker count
32	10+1+35=46
42	11+1+34=46
48	10+1+34=45
51.5	10+1+35=46
58.5	10+1+34=45
61	10+1+34=45
75	10+1+36=47

The color pattern of the young of both species is essentially the same, although in specimens of equal size *tapeinosoma* is slightly darker in color and the pattern more widely distributed. In the smaller specimens of both species the most pronounced areas of pigmentation are on the upper jaw, tip of lo jaw, tip of snout, around the posterior-ventral mar of the eye, the operculum, dorsally on head betw the eyes, dorsally along midline of back, along m line of sides, along base of anal fin, and around b of urostyle. Large chromatophores in the per neum are visible through the thin body wall es cially behind and below the base of the pectoral The pigmentation of the first dorsal fin is sligh more in *Auxis tapeinosoma* than in *thazard*. In latter species the first dorsal is colorless except fo slight pigmentation along the edge of the ante rays, while in the former the anterior interspin membranes are lightly pigmented, especially dista As the two species increase in size the localized ar of pigmentation gradually spread until finally color reaches the midline of the sides anteriorly to the anal base posteriorly. A faint longitudi dark band extends along midline of sides, borde above and below by slightly less pigmented ar The head also becomes progressively more pigmen as the fish increases in size. The fins remain un mented except the first dorsal which becomes ligh tinged with brown especially distally on the poste interradial membranes in *thazard*, and similar darker in *tapeinosoma*.

In the smaller specimens the dorsal and ven outlines are distinctly angulated. Both outlines flat and almost parallel to one another from posterior part of the head to beneath the sec dorsal fin. At this point the outlines bend abrup toward the caudal region. The dorsal outline of snout is distinctly angular. Both the dorsal ventral outline become more broadly and eve rounded as the fish increase in size.

Preopercular spines are present on the fish up at least, 30 mm. standard length. On one sm

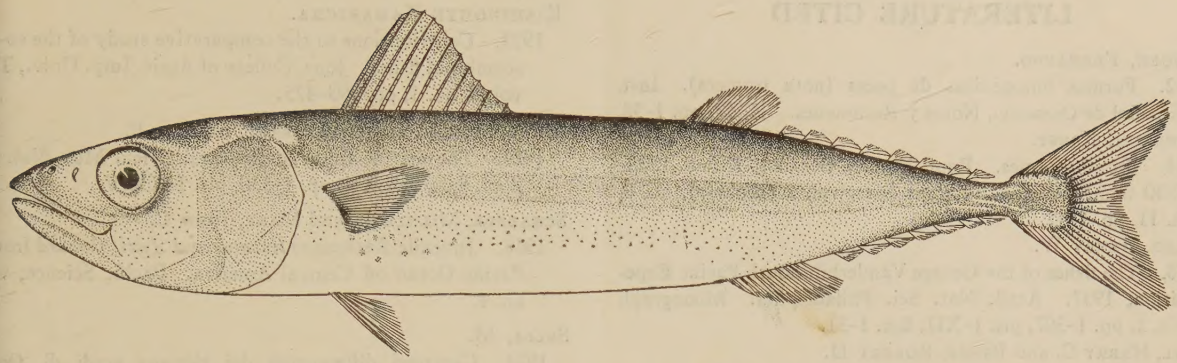

FIGURE 9.—Juvenile *Auxis tapeinosoma*, 54 mm. fork length.

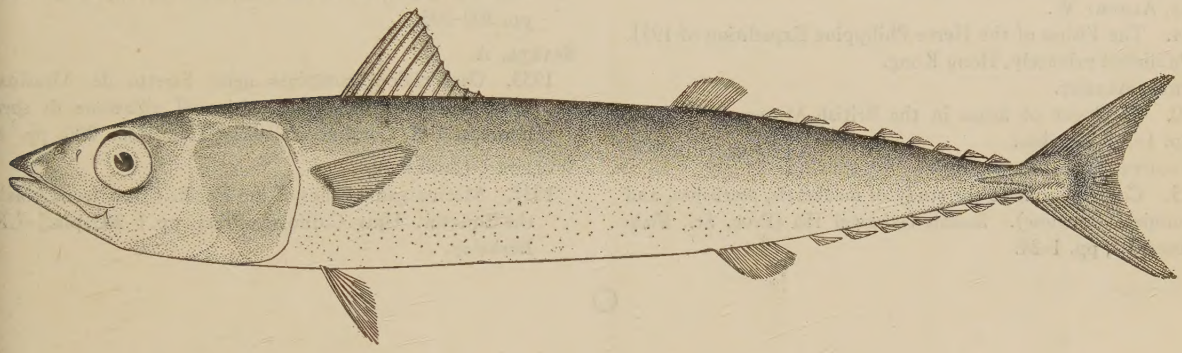

FIGURE 10.—Juvenile *Auxis tapeinosoma thazard*, 79 mm. fork length.

cimen of 21.3 mm. five spines are visible, but on 25.6-mm. specimen only three spines were seen. the larger specimens spines are not visible, being ıcealed in the tissue covering the preoperculum. ıaefer and Marr (1948) counted 9 preopercular nes in stained specimens.

A single row of small, conical, pointed teeth is sent on each jaw. Philippine specimens are sim- in this respect to those from the eastern Pacific h about 20 teeth on each side of the upper jaw, l about 25 on each side of the lower jaw. A few ıute granulations are present on the palatines, there is no evidence of teeth on the vomer of ıer species.

SUMMARY

The genus *Auxis* family Scombridae is a food fish some importance in the Republic of the Philip- es. Until recent investigations by biologists of Philippine Fishery Program of the Fish and dlife Service, it was thought that the commer- catch was composed of only one species. It can be shown that two species are present, *Auxis zard* and *Auxis tapeinosoma*. The two species can readily distinguished by the differences in gill-raker counts and the structure of the corselet. In *A. thazard* the total gill-raker count of the first gill arch is 37 to 43, and in *A. tapeinosoma* it is mostly 44 to 47 (43 in one of 55 specimens). The posterior prolongation of the corselet along the lateral line tapers abruptly in *thazard* and is only 2 to 4 scale rows wide below the origin of the second dorsal, while in *tapeinosoma* it tapers evenly and gradually throughout its length, being 7 to 12 irregular scale-rows wide under the origin of the second dorsal.

Juvenile forms of the genus *Auxis*, previously unknown from the Indo-Pacific region, have been collected and identified as to species. As with the adults, they can be separated into two species on the basis of gill-raker counts. These counts correspond to the adults of the two species found in Philippine waters, *A. thazard* and *tapeinosoma*. One juvenile and one adult specimen with lower gill-raker counts point to the possibility that perhaps a third species may be found, although it seems to be extremely rare. No attempt has been made to revise the confused systematic status of this genus, since neither adequate collections nor library are available for study. Rather, it is hoped that the data assembled here will aid future research on this genus.

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